PRICE $5.00

Model BKF 15–1.2

Serial No. P104578

INSTRUCTION MANUAL

KEPCO®

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(212) 461-7000 • TWX #710-582-2631

KEPCO

BKF design group

MODULAR

POWER SUPPLY

Model BKF 15–1.2

Serial No. P 104578

INSTRUCTION MANUAL

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TABLE OF CONTENTS

PARAGRAPH		PAGE
	SECTION I – INTRODUCTION	
1-1	Scope of Manual	1-1
1-3	General Description	1-1
1-6	Specifications, General	1-1
1-7	Specifications, Voltage Regulation Mode	1-2
1-8	Specifications, Physical	1-2
1-9	Accessories	1-2
	SECTION II – INSTALLATION	
2-1	Unpacking and Inspection	2-1
2-3	Terminations	2-1
2-5	AC Power Requirements	2-1
2-7	Grounding	2-2
2-9	Isolation	2-2
2-11	Installation	2-2
2-13	Cooling	2-2
	SECTION III – OPERATION	
3-1	Load Connection	3-1
3-3	Remote Error Sensing	3-1
3-6	Output Voltage Adjustment	3-2
3-8	Current Limit Adjustment	3-2
3-10	Voltage Limit Adjustment (Models with Suffix "V" Only)	3-3/3-4
	SECTION IV – THEORY OF OPERATION	
4-1	Simplified Diagram Discussion	4-1
4-5	Circuit Description	4-2
	SECTION V – MAINTENANCE	
5-1	General	5-1
5-3	Disassembly	5-1
5-5	Internal Adjustments	5-2
5-7	Trouble Shooting	5-2
5-11	Power Supply Measurements	5-2
	SECTION VI – PARTS LIST AND DIAGRAMS	
6-1	General	6-1/6-2
6-3	Ordering Information	6-1/6-2

LIST OF ILLUSTRATIONS

FIGURE		PAGE
1-1	Power Supply, BKF Series (Typical)	iii/iv
1-2	Mechanical Outline Drawing	1-3/1-4
2-1	BKF Power Supply, Terminations	2-1
2-2	Conversion to 230 V AC Line Operation	2-1
3-1	Load Connection and Output Measurements	3-1
3-2	Load Connection with Remote Error Sensing	3-1
3-3	Location of Internal Adjustments	3-2
4-1	Simplified Block Diagram, BKF Series	4-1
4-2	Foldback Characteristics, BKF Current Limit Circuit	4-3/4-4
5-1	Disassembly, BKF Series	5-1
5-2	Regulation Measurements	5-3/5-4
5-3	Approximation of a Four-Terminal Network	5-3/5-4
6-1	Component Location, Main Chassis	6-9/6-10
6-2	Component Location, Printed Circuit Board (A1)	6-9/6-10
6-3	Main Schematic	6-11/6-12

LIST OF TABLES

TABLE		PAGE
1-1	General Specifications, BKF Series	1-1

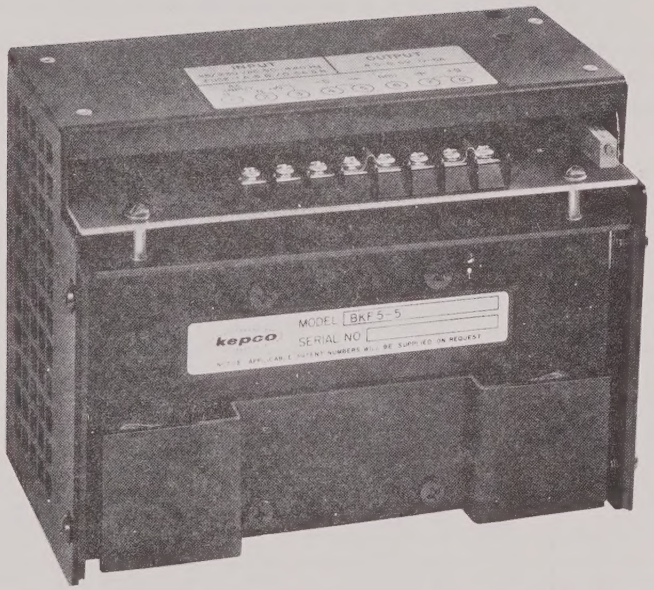

FIG. 1-1 BKF POWER SUPPLY, MODULE, TYPICAL

Guide QQFU2. September 14, 1970 E47556.
Component—Power Supplies.

Kepco, Inc.,
131-138 Sanford Ave., Flushing, N. Y. 11352

Industrial: For use in graphic arts equipment, electronic data processing equipment, office appliances and business equipment, and photo processors (electronic), Models BKF-5-3, -5-5, -12-1.4, -12-2.4, -15-1.2, -15-2, -24-0.8, -24-1.2, -28-0.6, -28-1.
Marking: Company name and model designation.

See General Information Card of above guide designation.

For use only in equipment where the acceptability of the combination is determined by Underwriters' Laboratories, Inc.

Report: August 19, 1970.

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SECTION I – INTRODUCTION

1-1 SCOPE OF MANUAL

1-2 This manual contains instructions for the operation and maintenance of the Kepco BKF Series of DC Regulated Power Supplies.

1-3 GENERAL DESCRIPTION

1-4 Kepco BKF units are voltage regulated DC power supplies of modular construction. Their mechanical dimensions and electrical specifications are identical, except as noted in TABLE 1-1.

1-5 BKF Power Supplies feature fixed voltage output (±10% adjustable), completely short-circuit proof design by means of an adjustable current "fold-back" circuit and fixed overvoltage protection* with a built-in electronic "crowbar". BKF modules are designed with IC monolithic voltage regulators and temperature compensated reference voltages for low temperature coefficients and high output stability.

MODEL	D-C OUTPUT RANGE		MAXIMUM OV TRIP* POINT (VOLTS)	OUTPUT IMPEDANCE OHMS + MICROHENRIES			MAXIMUM A-C INPUT CURRENT (at 125V A-C)
	VOLTS	AMPS		D-C to 100 Hz	100 Hz to 1 kHz	1 kHz to 100 kHz + μH	
BKF 1.25–7V	1.25 ±10%	0–7	▲	0.001	0.02	0.1 + 1	0.7
BKF 3.5–5V	3.5 ±10%	0–5	▲	0.001	0.02	0.1 + 1	0.7
BKF 5–3	5.0 ±10%	0–3	6.5	0.003	0.02	0.1 + 1	0.6
BKF 5–5	5.0 ±10%	0–5	6.5	0.001	0.02	0.1 + 1	0.9
BKF 12–1.4	12.0 ±10%	0–1.4	15.3	0.009	0.02	0.1 + 1	0.6
BKF 12–2.4	12.0 ±10%	0–2.4	15.3	0.005	0.02	0.1 + 1	0.7
BKF 15–1.2	15.0 ±10%	0–1.2	19.5	0.013	0.02	0.1 + 1	0.6
BKF 15–2	15.0 ±10%	0–2	19.5	0.008	0.02	0.1 + 1	0.8
BKF 24–0.8	24.0 ±10%	0–0.8	30.0	0.03	0.05	0.1 + 1	0.6
BKF 24–1.2	24.0 ±10%	0–1.2	30.0	0.02	0.05	0.1 + 1	0.7
BKF 28–0.6	28.0 ±10%	0–0.6	35.3	0.05	0.05	0.1 + 1	0.5
BKF 28–1	28.0 ±10%	0–1	35.3	0.03	0.05	0.1 + 1	0.7

▲ Available in "–V" Option ONLY.

TABLE 1-1 GENERAL SPECIFICATIONS, BKF SERIES.

1-6 SPECIFICATIONS, GENERAL

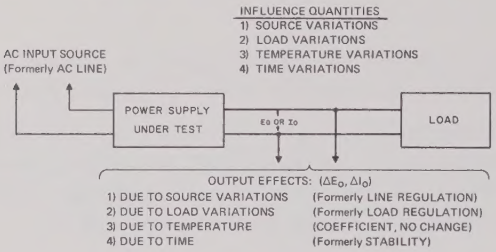
a) INPUT: 105 to 125 V AC or 210 to 230 V AC (selectable, refer to paragraph 2-5) 50 to 440 Hz, single phase. See TABLE 1-1 for the input current on each model.
b) OPERATING TEMPERATURE: 0 to 55°C.
c) STORAGE TEMPERATURE: –40°C to +85°C.
d) COOLING: Convection.
e) ISOLATION VOLTAGE: A maximum of 500 V (DC or p-p) can be connected between chassis and either output terminal.

***NOTE:** The overvoltage trip-point on models with suffix "V" can be adjusted over the specified DC output voltage range.

1-7 SPECIFICATIONS, VOLTAGE REGULATED MODE

NOTE: With the introduction of the 1970 Catalog (B-703), Kepco has adopted new technical terms recommended by the International Electrotechnical Commission (IEC). These terms replace or supplement previously used expressions, mainly to avoid difficulties in translation and prevent erroneous interpretations at home and abroad.

As a beginning, Kepco will discontinue the use of the specifications entitled "Line Regulation" and "Load Regulation" because of the long standing (and misleading) connotation that a power supply regulates the line or the load. Instead, Kepco will follow the recommendation of the IEC and speak of the "Output Effects, caused by changes in the Influence Quantities." The "Output Effects" are specified as before, either as a percentage change referred to the maximum specified output voltage (E_O) or current (I_O) or as an absolute change (ΔE_O, ΔI_O) directly in millivolts or milliamperes or both. The "Influence Quantities" are the "Source Variations" (formerly AC line variations), the changes in load, temperature or time as previously specified. The illustration below will clarify the use of the new terminology.



a) OUTPUT EFFECTS:
   1) DUE TO AC INPUT SOURCE VARIATIONS: Less than 0.05% output voltage change for 105 to 125 V AC or 210 to 250 V AC source variation at any output voltage within the specified range.
   2) DUE TO LOAD VARIATIONS: Less than 0.05% or 2.5 mV, w.i.g. (except 5 mV on Model BKF 1.25–7–V) output voltage change for "no load" to "full load" change at any output voltage within the specified range.
   3) DUE TO TIME: Output voltage varies less than 0.05% over a period of 8 hours after warm-up measured at constant line voltage, load and ambient temperature.
   4) DUE TO TEMPERATURE: Output voltage changes less than 0.05% per °C.

b) RIPPLE: Less than 0.5 mV rms.

c) RECOVERY TIME: Less than 50 μsec to return from a load current step to the regulation band defined in (h).

d) OVERVOLTAGE PROTECTION:
   1) STANDARD MODELS: SCR "crowbar," maximum trigger point voltage tabulated for each model in Table 1-1. Trigger time less than 10 μsec.
   2) MODELS WITH "V" SUFFIX: SCR "crowbar," trigger point voltage adjustable from (−)10% to (+)20% of the nominal output voltage of each model. Trigger time less than 10 μsec.

e) CURRENT LIMIT: Adjustable, approximate range 10% to 110% of the rated output current. Modified foldback characteristic (re-entrant) permits certain nonlinear loads to be started without the necessity of a "starting resistance."

f) REMOTE ERROR SENSING: Compensates for a maximum voltage drop of 0.5 V per load lead.

g) OVERSHOOT (Turnon/Turnoff): None.

h) SERIES/PARALLEL OPERATION: Models may be series connected up to their rated isolation voltage. (See Section III.) No provisions for parallel operation.

1-8 SPECIFICATIONS, PHYSICAL

a) DIMENSIONS: See FIG. 1-2, "Mechanical Outline Drawing."

b) FINISH: Black anodized chassis and cover.

c) TERMINATIONS: All AC input and DC output connections are made on the eight-terminal barrier-strip.

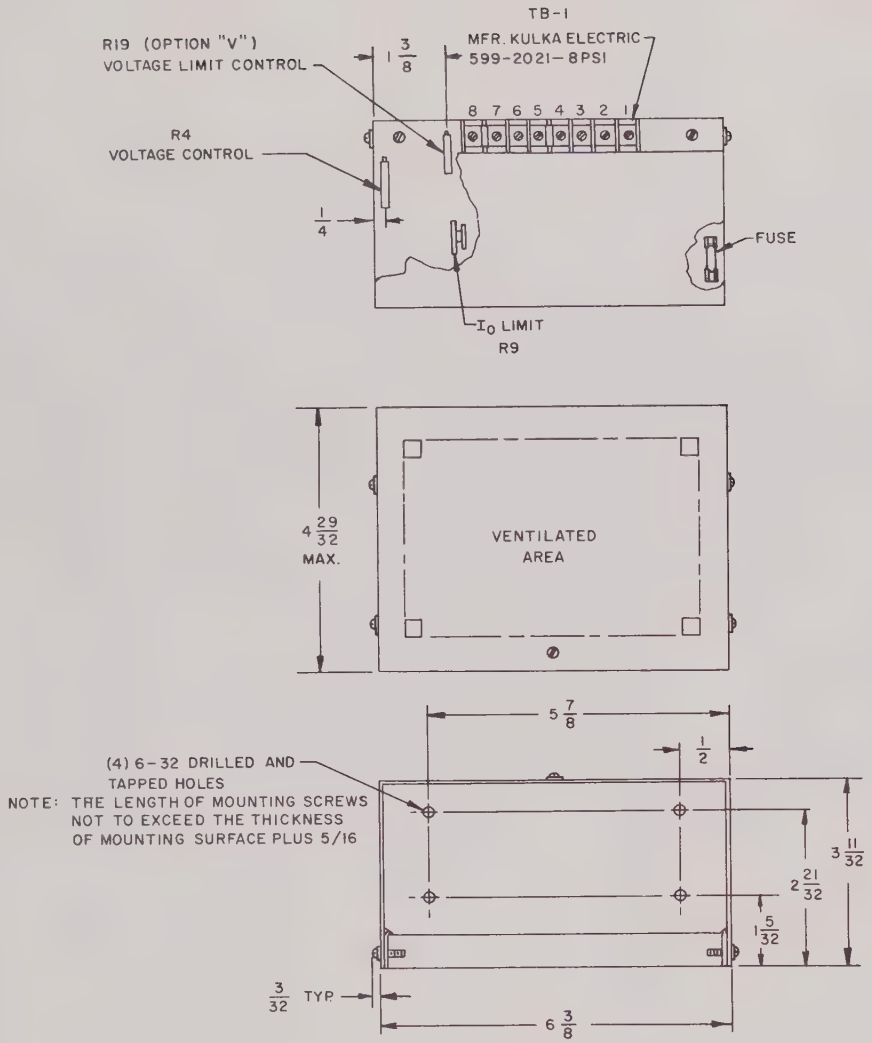
d) MOUNTING: Rack adaptors available. (Refer to Paragraph 1-9 "Accessories.")

1-9 ACCESSORIES

a) RACK ADAPTOR (For one unit), Kepco Model RA 26–1.

b) RACK ADAPTOR (For two units), Kepco Model RA 27–2.

c) RACK ADAPTOR (For four units), Kepco Model RA 28–4.



REAR OUTPUT TERMINAL FUNCTIONS (TB-1)

1 AC LINE (HOT)
2 AC LINE (NEUTRAL)
3 AC (GROUND)
4 (–) ERROR SENSING
5 (–) OUTPUT
6 GROUND
7 (+) OUTPUT
8 (+) ERROR SENSING

NOTES:

1 THIS DRAWING USED FOR BKF-GROUP (1)
2 MATERIAL COVER #16 GA AL.
CHASSIS #11 GA. AL.
3 FINISH: CHASSIS AND COVER BLACK ANODIZE
4 FUSE DATA 115 V AC – 1.5 A INST.
230 V AC – 0.75 A INST.
5 INTERNAL ADJ. (R4, R19) ARE
ACCESSIBLE WITHOUT CASE REMOVAL.

FIG. 1-2 MECHANICAL OUTLINE DRAWING

SECTION II – INSTALLATION

2-1 UNPACKING AND INSPECTION

2-2 This power supply has been inspected and tested at the factory prior to packing and is shipped ready for operation. After careful unpacking inspect for shipping damage before attempting to operate the power supply. If there is any evidence of damage, notify the responsible transport service immediately.

2-3 TERMINATIONS

2-4 All AC input and DC output connections are made at the eight (8) terminal barrier-strip as shown in FIG. 2-1.

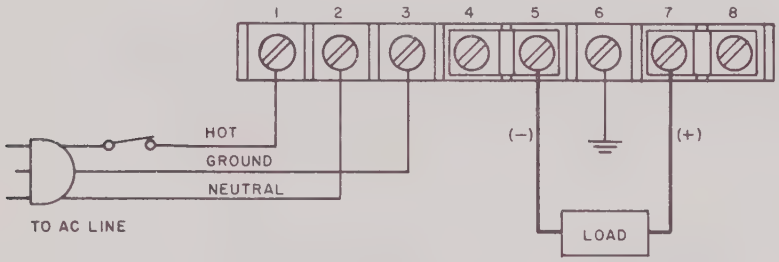


FIG. 2-1 BKF POWER SUPPLY, TERMINATIONS

2-5 AC POWER REQUIREMENTS

2-6 This power supply is normally shipped for operation on a nominal 115V AC line, single phase. If 230V AC operation is desired, the transformer primary link connections must be changed as shown in FIG. 2-2.

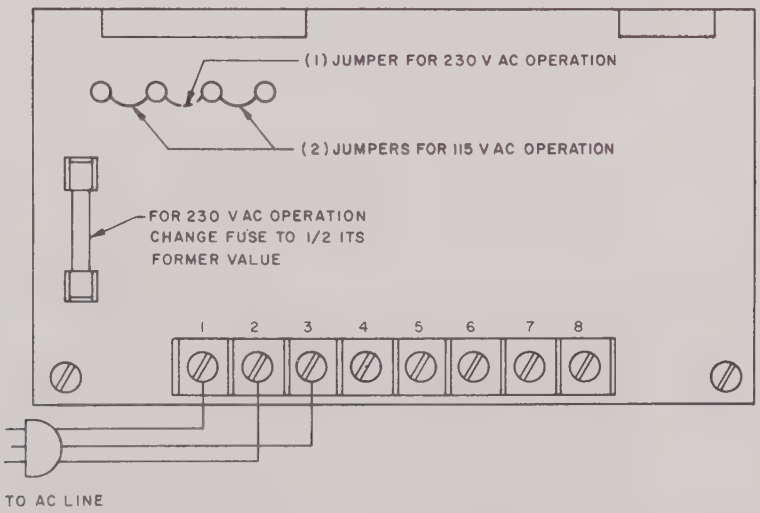


FIG. 2-2 CONVERSION TO 230V AC OPERATION

2-7 GROUNDING

2-8 For safety reasons it is important that the metal chassis of the power supply be connected to an AC ground. If a three-wire line cord and a properly grounded outlet is used, the grounding is automatically accomplished. If only a two-wire line cord is used, the metal chassis of the power supply must be grounded separately by returning barrier-strip terminal (3) to an AC ground.

2-9 ISOLATION

2-10 The DC output terminals of the power supplies are isolated from the AC power line and from the chassis. Since no DC connection exists to the chassis, either side of the power supply may be grounded. A maximum of 500 V (DC or p-p) can be connected between chassis and either output terminal.

2-11 INSTALLATION

2-12 The BKF power supply may be chassis-mounted directly into existing installations, or it may be installed into any standard "19 inch" rack with the assistance of a suitable rack adaptor. (See Par. 1-9, "ACCESSORIES,") Mounting hole layout and dimensions are presented in the "Mechanical Outline Drawing," FIG. 1-2. If the power supply module is rack-mounted or installed into confined spaces, refer to Paragraph 2-13.

2-13 COOLING

2-14 This power supply is designed to be operated, without additional heat sink or external cooling, within the temperature limits specified. (See Section I) SIDE PANEL OPENINGS AND TOP OF COVER MUST BE KEPT FREE FROM OBSTRUCTIONS to insure proper air circulation and convection cooling. If the power supply is rack-mounted or installed into confined spaces, care must be taken that the ambient temperature does not rise above the specified limit. (See Section I)

SECTION III – OPERATION

3-1 LOAD CONNECTION

3-2 The load should be connected to the barrier-strip terminals as shown in FIG. 3-1. The load connecting wires should be as heavy gage as practicable, since voltage drops due to load current flow will influence regulation performance directly at the load. Specified regulation performance must be measured as indicated in FIG. 3-1 and as described in detail in Section V of this manual.

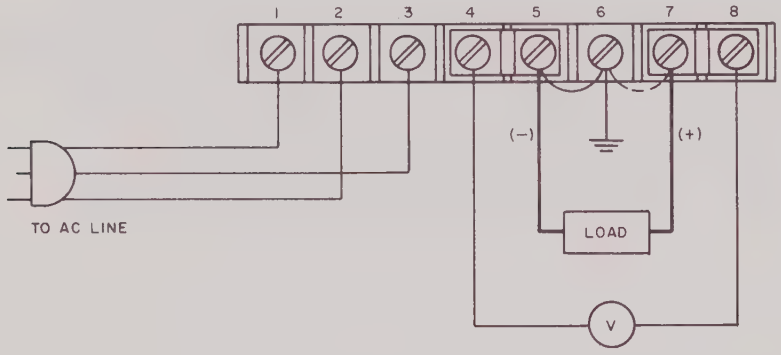


FIG. 3-1 LOAD CONNECTION AND OUTPUT MEASUREMENTS

3-3 REMOTE ERROR SENSING

3-4 Specified DC performance DIRECTLY AT THE LOAD requires the use of remote error sensing. A twisted, shielded pair of wires is connected from the sensing terminals of the power supply (4,8) to the remote load. (See FIG. 3-2) Observe polarities: The negative sensing lead (from terminal 8) to the positive load side. Sensing wire diameter should be at least No. 20 AWG. For lowest output noise and ripple, either plus (+) or minus (–) output may be grounded.

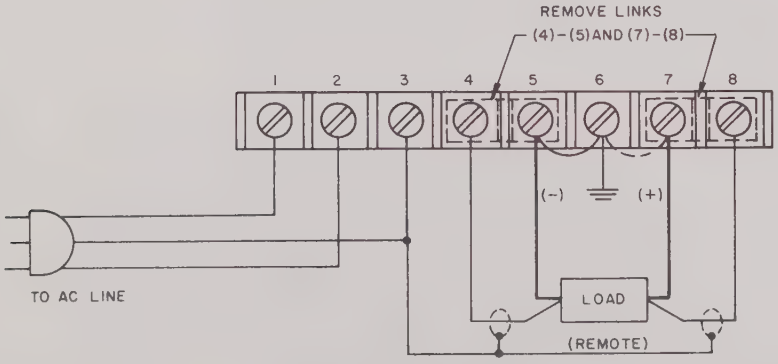


FIG. 3-2 LOAD CONNECTION WITH REMOTE ERROR SENSING

3-5 With remote error sensing, load wire voltage drops (due to load current) up to 0.5 volts per load wire can be compensated.

CAUTION

While the load is protected by built-in diodes, open load or error sensing wires can cause damage to the power supply. Before connecting remote error-sensing, the supply should always be turned off. Load wires as well as sensing wires should be securely fastened to the rear barrier-strip of the power supply and to the remote load.

3-6 OUTPUT VOLTAGE ADJUSTMENT

3-7 The DC output voltage can be adjusted ±10% around the nominal rated value. A multiturn trimmer potentiometer is provided for this purpose on the printed circuit board. (Refer to FIG. 3-3) Connect the power as indicated in FIG. 3-1, connect to AC power line and adjust "E_O Adj." as desired. The accuracy of the adjustment is limited only by the accuracy of the connected voltmeter.

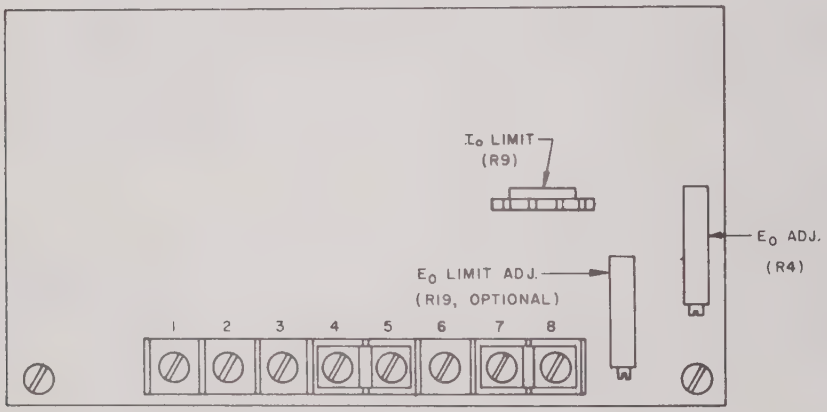


FIG. 3-3 LOCATION OF INTERNAL ADJUSTMENTS

3-8 CURRENT LIMIT ADJUSTMENT

3-9 The output current of the BKF Power Supply is factory-adjusted to limit at approximately 110% of the maximum rated value. If a lower limit is desired, it may be readily adjusted to any value between 30% and 110% of the maximum rated output current. A single-turn potentiometer (R9, "I_O LIMIT") located on the printed circuit board (Refer to FIG. 3-3) is provided for this purpose. A convenient way to set the current limit is as follows:

a) Set up the power supply as shown in FIG. 3-1 and adjust the resistor load to draw the desired output current. Monitor the output with an oscilloscope (parallel to the load) having a vertical sensitivity of at least 0.1mV/cm.

b) Observe the output ripple. Turn the current limit adjustment ("I_O LIMIT", R9) slowly counterclockwise until the output ripple increases substantially. This shows the power supply is now operating in the current limiting mode. Turn "I_O LIMIT" slightly clockwise again such that the output ripple appears normal again. This concludes the current limit adjustment. NOTE: DO NOT ADJUST "I_O LIMIT" TO MORE THAN 110% I_O! Although this may be possible due to component tolerances, overheating of the pass-elements and their subsequent destruction will result if the maximum rated output current is exceeded.

3-10 VOLTAGE LIMIT ADJUSTMENT (MODELS WITH SUFFIX "V" ONLY)

3-11 The output voltage of the BKF power supply is factory-adjusted to its nominal rated value (E_O nom). The voltage limit control ("E_O LIMIT" R19) is factory set to crowbar the output at "E_O nom. + 10%". The voltage limit control may, however, be reset to any other trip-point within the rated output range (E_O nom. ±10%) and as close as to within 5% or 0.25 volt (whichever is greater) of the power supply output voltage. Correct the power supply to the AC line and proceed as follows:

a) With the voltage limit control (R19) fully clockwise, set output voltage by means of the "E_O Adj." control (R4) as required.

b) Monitoring the output with a suitable voltmeter, turn the "E_O LIMIT" control (R19) SLOWLY counterclockwise, until the power supply "crowbars," indicated by the output voltage going to near zero volts. Turn "E_O LIMIT" control VERY SLIGHTLY clockwise again: The amount of "threshold" or difference voltage between operating voltage and the trip-point (crowbar point) is determined by this last adjustment. A too close adjustment of the trip-point towards the operating voltage may lead to spurious triggering. (The minimum "threshold" or difference voltage adjustable is specified as 5% E_O nom. or 0.25 volt, whichever is greater.)

c) Reactivate the overvoltage protection circuit by disconnecting and than reconnecting the AC line at the power supply. Check the adjusted trip-point by observing the voltmeter at the output and turning the "E_O Adj." control until the power supply "crowbars" again. Repeat adjustment if required.

SECTION IV – THEORY OF OPERATION

4-1 SIMPLIFIED DIAGRAM DISCUSSION (Refer to FIG. 4-1)

4-2 The POWER TRANSFORMER converts the AC line voltage to the levels needed for production of the unregulated voltages for the MAIN and the AUXILIARY DC SUPPLIES. The MAIN DC SUPPLY is "in series" with the PASS-ELEMENT and the SENSING RESISTOR and produces the DC output voltage. The output voltage is kept constant by the changing series resistance of the PASS-ELEMENT, which receives the necessary drive from the DRIVER. The DRIVER in turn receives its command signals either from the voltage amplifier or the current limit amplifier contained in the IC REGULATOR.

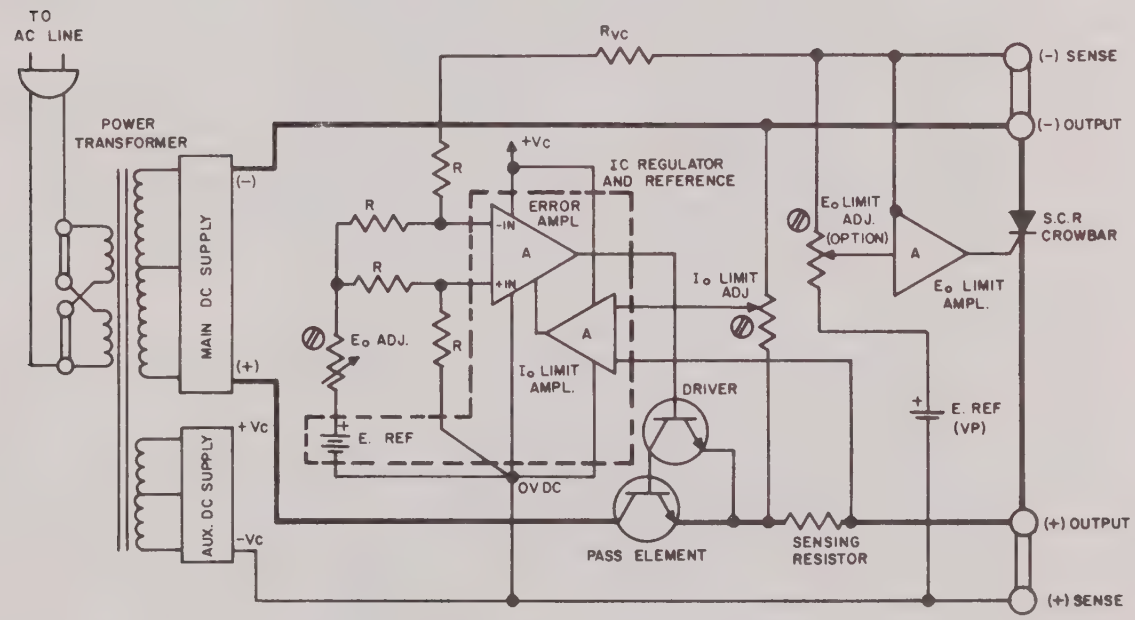


FIG. 4-1 SIMPLIFIED BLOCK DIAGRAM, BKF SERIES

4-3 The OUTPUT VOLTAGE is constantly compared to the reference voltage in the IC REGULATOR, while the output current is monitored by the SENSING RESISTOR. Any change in either output voltage or current is amplified by its associated amplifier in the IC REGULATOR and transferred as a command to the DRIVER which produces the appropriate signal to the PASS-ELEMENT, thus either keeping the output voltage constant, or if the signal from the current limit amplifier is dominant, limiting the output current to the preadjusted value at "I_O LIMIT".

4-4 The OVERVOLTAGE PROTECTOR senses the output voltage via its own zener reference. If for any reason the output voltage exceeds its nominal value, a turn-on signal for the SCR is produced across the output. The SCR will crowbar the output as long as the overvoltage persists. Recycling takes place by the momentary removal of the primary AC power.

4-5 CIRCUIT DESCRIPTION (Refer to Main Schematic, FIG. 6-3)

4-6 For the purpose of analysis, the circuitry of the BKF Power Supply may be divided into several sections which are subsequently described below. Refer to the main schematic diagram, FIG. 6-3.

a) AC INPUT CIRCUIT. AC line power is introduced through rear barrier-strip (TB1), terminals (1) and (2). Terminal (3) is connected to the chassis and should always be returned to AC ground. The fuse (F1) protects the primary of the power transformer (T201) from excessive current. T201 has two primary windings which are connected either in parallel (for 115 V AC service) or in series (for 230 V AC service).

b) MAIN DC POWER SUPPLY. The main DC power is derived from a secondary winding on T201. Rectification and capacitive filtering are performed with silicon diodes (CR3,CR4) and the input capacitor (C2). The main DC power supply delivers the output current and the operating voltages for the series pass-element.

c) PASS-ELEMENT CIRCUITRY. The pass-element or series control transistor (Q201) is connected in series with the plus (+) output terminal, the external load and the unregulated raw DC voltage from the main power supply. By changing the equivalent resistance of the pass-element, the voltage drop across it is changed in such a way as to keep the output voltage across the external load constant. The base drive current needed to effect the pass-element voltage drop is supplied by the driver stage (Q202) which in turn is driven by the regulator circuit (IC–1).

d) PRECISION VOLTAGE REGULATOR. An integrated circuit voltage regulator (IC–1) provides the temperature compensated reference source, the error amplifier and part of the current limit circuitry. The output and the reference voltage are compared at the differential input of the amplifier. Any deviation at the output, caused for example by AC line variations or DC load conditions, will produce a deviation from zero between the differential input (error signal). This error signal is then amplified by the error amplifier and acts as a control signal for the internal predriver, the external main driver and finally for the external pass-element, changing the voltage drop across the latter in such a way as to correct the original output deviation and restoring the "zero" condition at the differential input of the error amplifier.

e) CURRENT LIMIT CIRCUITRY. The output current is constantly monitored by the "sensing resistor" (R10). The voltage drop across R10 (due to the flow of output current), is continuously compared to a portion of the output voltage, determined by the setting of the "I_O LIMIT" control. At balance, the current limit circuit consisting of the external current limit stage (Q1,Q2) and the internal limiting stage (I_O Limit, part of IC-1), is inactive and the "error amplifier" (Part of IC-1) is in control. As the voltage drop across the "sensing resistor" (R10) increases (due to increasing load current), a point is reached, determined by the setting of the "I_O LIMIT" control, where the current limit circuitry takes control away from the "error amplifier" and starts to reduce the drive to the internal predriver stage, the external main driver, and finally, the main pass-element. The resulting output current limit action, when viewed in the E_O/I_O plane, has "modified foldback" characteristics as indicated in FIG. 4-2.

f) OVERVOLTAGE PROTECTION CIRCUIT. The output voltage of the power supply is continuously compared with the reference level produced by the (forward biased) zener diode (CR8). This reference level is fixed and dependent on the zener voltage of CR8 in standard BKF models. In BKF models with suffix "V," the reference level may be adjusted by means of the "E_O LIMIT" control, a multiturn potentiometer (R19). For output voltages below the reference level, the overvoltage protection circuitry is inactive and does not influence the operation of the power supply. Should, for any reason, the output voltage assume a value exceeding the reference level, the zener diode (CR8) will conduct and turn on the amplifier stage (Q3), which in turn will deliver a turn-on signal to the silicon-controlled rectifier (CR7), which is connected across the output terminals, acting as an electrical "crowbar." As the "crowbar" conducts, it reduces the output voltage of the power supply to a level equal to the forward conduction voltage drop of the SCR approximately 0.7 volts). The SCR will stay in its conductive state until:

1) The overvoltage condition is removed AND:
2) The protective circuit is reactivated by removing and reapplying the AC input power at the power supply.

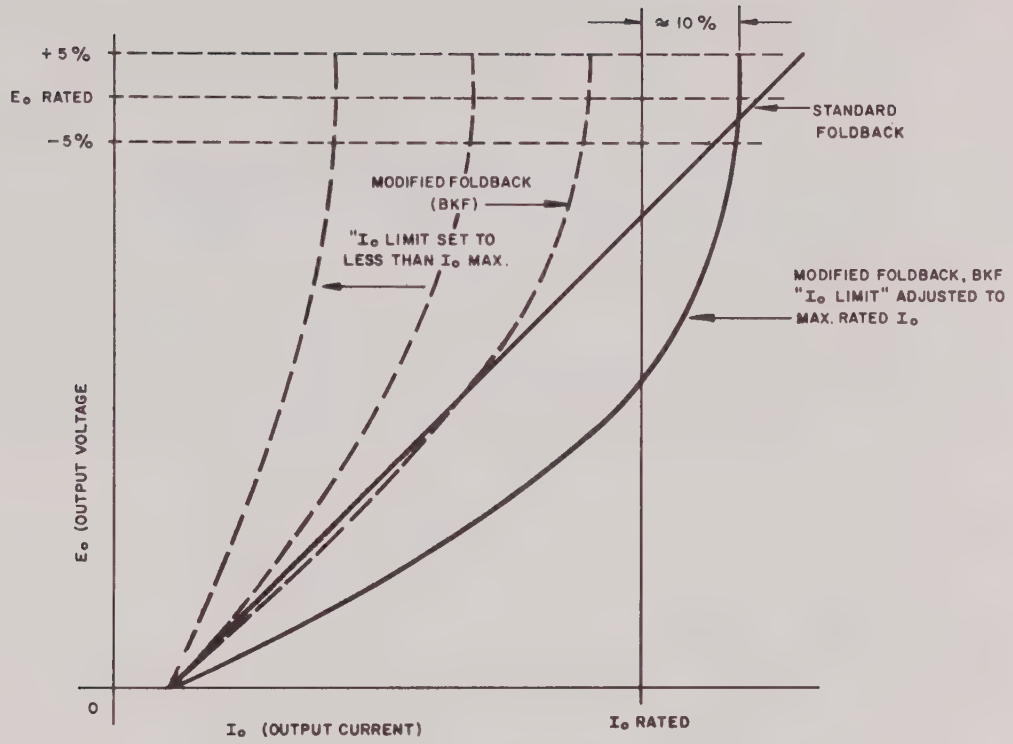


FIG. 4-2 FOLDBACK CHARACTERISTICS, BKF CURRENT LIMIT CIRCUIT

g) AUXILIARY SUPPLY. The auxiliary DC voltage for the operation of the IC regulator is derived either from the main secondary winding on T201 (models with E_O =5 V), or from a separate secondary of the power transformer (all others). The full-wave rectified voltage (CR1,CR2) is capacitor-filtered (C1).

SECTION V – MAINTENANCE

5-1 GENERAL

5-2 This section covers maintenance procedures and performance measurements for Kepco BKF Series Power Supplies. Conservative rating of components and the non-congested lay-out should keep maintenance problems to a minimum. If trouble does develop however, the easily removed wrap-around cover and the plug-in feature of the printed circuit board provide exceptional accessibility to all components of the power supply.

5-3 DISASSEMBLY (Refer to FIG. 5-1)

5-4 The wrap-around cover may be easily lifted from the power supply by loosening and removing the five (5) holding screws (2 on each side, one on top). The PCB assembly can be dismounted by removing the four (4) holding screws and the two PCB connectors.

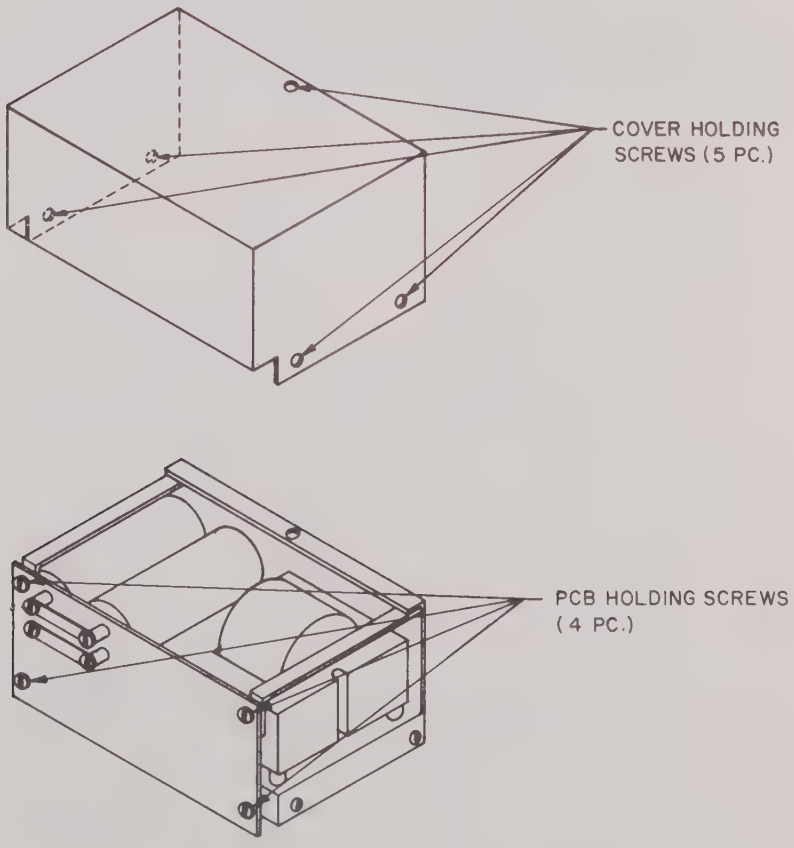


FIG. 5-1 DISASSEMBLY, BKF SERIES

5-5 INTERNAL ADJUSTMENTS

5-6 BKF Power Supplies have their internal controls located at the printed circuit board (See FIG. 3-3). The adjustment procedures for the voltage calibration potentiometer, the current limit control, and the (optional models with suffix "V") voltage limit control are described in Section III. (See paragraphs 3-6, 3-8 and 3-10)

5-7 TROUBLE SHOOTING

5-8 Modern, high performance power supplies have reached a state of sophistication which requires thorough understanding of the problems involved in repairing complex, solid-state circuitry. Servicing beyond simple parts replacements should consequently be attempted only by personnel thoroughly familiar with solid-state component techniques and with experience in closed loop circuitry.

5-9 Trouble shooting charts, showing resistance and voltage readings, are of very limited usefulness with feedback amplifiers and are not included here. Instead a detailed circuit description (Section IV), parts location diagrams, simplified functional schematics and a main schematic with all significant voltage readings are presented.

5-10 The following basic steps in case of power supply malfunctioning may also be found helpful:

a) NO OUTPUT:
   1) If power supply does not function at all, check obvious points first: Check power line connections, correct line voltage and frequency (normally the power supply is delivered for 115 V AC service). Check fuse and replace if open.
   2) Check if voltage protector is tripped, by momentary interrupting the AC input.
   3) Check if current limit has been inadvertently misadjusted. Readjust by referring to paragraph 3-8.
   4) Check reference voltage (IC—1, pin 6 to (—) output). It should be approximately 7 volts.
   5) Check indicated voltage readings on the main schematic and start circuit analysis with the help of Section IV.

b) HIGH OUTPUT: Most of the checks outlined above are also applicable for this condition. In addition, check the following:
   1) Test main driver and pass-element by connecting a 6 V dry battery from the (+) output (negative side of battery) to first pin 6 and then pin 5 of J202, disconnecting the latter from the printed circuit board. Observe the result on a voltmeter connected across the output. Functioning driver and pass-elements should yield readings of approximately 5.3 V and 4.7 V respectively. If shorted transistors are suspected, confirm by testing with an ohmmeter from emitter to collector. Polarity reversal on the meter leads should produce an approximately 1:4 resistance ratio on "good" transistors. Replace only with listed types if defective.

c) POOR PERFORMANCE
   1) Excessive output effects are often due to incorrectly connected loads or faulty measurement techniques. Perform measurements only as directed in paragraph 5-11 and follow the connection diagrams.
   2) High frequency oscillations at the output are often due to loads with large inductive or capacative components and/or long load wires. Tightly twisted load wires of sufficient diameter and kept as short as possible are often the solution to the problem. In extreme cases, decoupling DIRECTLY AT THE LOAD with appropriate capacitance should be applied.
   3) High ripple at the output or the load may be caused by ground loops or long load wires passing through magnetic fields. Grounding of one side of the output and careful lead dressing (see comments under paragraph 5-10 c-2) is often helpful.

d) KEPCO Field Engineering offices, or the KEPCO Application Engineering Department are always available for consultation or direct help in difficult service or application problems.

5-11 POWER SUPPLY MEASUREMENTS

5-12 Voltage regulation and output ripple measurements are an excellent indication of the power supply's DC performance and may be performed with a minimum of instrumentation. Since these measurements require special techniques to insure correct results, suggestions for their performance are given below:

a) Required Instrumentation:
   1) Constant AC supply voltage with provisions for "stepping" the voltage over a specified region (105-125 V); a variable autotransformer is generally adequate, if it is rated to deliver the input current of the unit under test.

2) Resistive load, variable, with ON/OFF switch and capable of dissipating the full output power of the unit under test.
3) DC voltage monitor, differential voltmeter, or power supply analyzer.
4) AC ripple monitor, sensitivity better than 1 mV. Ballantine Model 302C, or Hewlett Packard Model 400H.
5) Optional: Oscilloscope, vertical sensitivity better than 0.1 mV/cm.

b) The Four-Terminal Network is an essential device for precise measurement of regulation. It can be approximated by the method shown in FIG. 5-3.
FIG. 5-3 shows the proper location of instrument leads when measuring regulation. The principle governing this method of measurement is simply not to measure any voltage drops due to load current flow. This can only be avoided by measuring regulation with the test set up connected as shown in FIG'S 5-2,5-3.

c) Output effects due to AC source or DC load variations are defined as the amount of output voltage change resulting from a specified change of source voltage or from a change in load resistance. Output effects can be expressed as an absolute change ΔE_O or as a percentage in reference to the total output voltage E_O:

$$\% \text{ Output Effect} = \frac{\Delta E_O}{E_O} \times 100\%$$

d) Ripple: RMS ripple may be monitored on a true RMS reading instrument connected parallel to the regulation analyzer leads. Careful wire dressing and shielding, as well as good signal grounding are of the utmost importance if valid measurements are being expected. An oscilloscope may also be used for p-p readings of noise and ripple. An approximate RMS reading can be calculated from the p-p reading of the oscilloscope if the reading is divided by three.

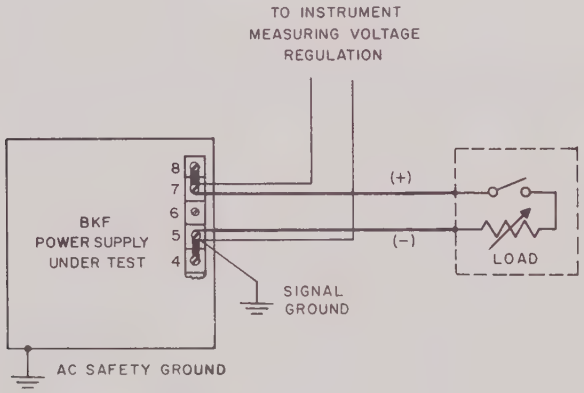


FIG. 5-2 REGULATION MEASUREMENT (VOLTAGE)

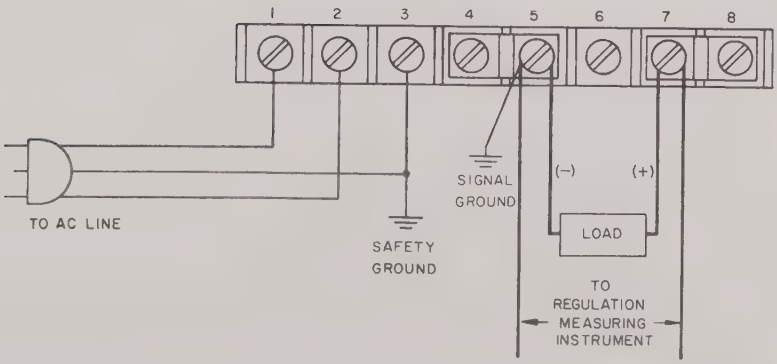


FIG. 5-3 APPROXIMATION OF A FOUR TERMINAL NETWORK

SECTION VI – ELECTRICAL PARTS LIST AND DIAGRAMS

6-1 GENERAL

6-2 This section contains the main schematic, the parts location diagrams, and a list of all replaceable electrical parts. All components are listed in alpha-numerical order of their reference designations. Consult your Kepco Representative for replacement of parts not listed here.

6-3 ORDERING INFORMATION

6-4 To order a replacement part or to inquire about parts not listed in the parts list, address order or inquiry either to your authorized Kepco Sales Representative or to:

KEPCO, INC.
131–38 Sanford Avenue
Flushing, N.Y. 11352

6-5 Specify the following information for each part:

a) Model and complete serial number of instrument.

b) Kepco part number.

c) Circuit reference designator.

d) Description.

6-6 To order a part not listed in the parts list, give a complete description and include its function and location.

PRINTED CIRCUIT BOARD ASSEMBLY (PCB–1), MODEL BKF 15–1.2 (V) Code 3-2570

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (SEE NOTE)	KEPCO PART NO.
C1	1	Capacitor,Electrolytic,Pigtail 75 μF, 50V	Sprague 30D756G050DF2	117-0646
C2	1	Capacitor,Electrolytic,Can 5.8 K μF, 40V	General Electric 86F500 Series	117-0782
C3	1	Capacitor,Mylar,Pigtail 0.1 μF, 200V	Sprague 192P10402	117-0186
C4	1	Capacitor,Ceramic,Disc 500 pF, 500V	Radio Materials Type JG	117-0755
C5	1	Capacitor,Mylar,Pigtail 0.02 μF, 200V	Sprague 192P20392	117-0377
C6	1	Capacitor,Electrolytic,Pigtail 75 μF, 30V	Sangamo 556DE750W030B	117-0772
C7,8	2	Capacitor,Electrolytic,Pigtail 150 μF, 3V	General Electric 76F02BF151	117-0512
C9	1	Capacitor,Mylar,Pigtail 0.01 μF, 200V	Sprague 192P10302	117-0353
CR1,2, 3,4,9,10	6	Rectifier,Silicon,Pigtail	Semtech SE-1	124-0133
CR5	1	Zener Diode	International Rectifier 1N3026B	121-0036
CR6	1	Zener Diode	Transitron 1N746A	121-0060
CR7	1	Rectifier,Silicon,Pigtail	Motorola 2N4441	124-0349
**CR8	1	Zener Diode	Microsemiconductor Corp. MTZ620A	121-0071
*CR8	1	Zener Diode	Transitron 1N746A	121-0060
CR11,12	2	Rectifier,Silicon,Pigtail	EDI CEC1000	124-0178
F1	1	Fuse,Instantaneous 1.5A	Bussman AGX-1 1/2	141-0073
IC-1	1	Integrated Circuit	Kepco 250-0021	250-0021
Q1,2	2	Transistor,NPN	Fairchild 2N5133	119-0093
Q3	1	Transistor,PNP	Fairchild 2N5138	119-0096

*Component used in models with suffix "V" only.
**Component used in models without suffix only.

NOTE:
REPLACEMENT PARTS MAY BE ORDERED FROM KEPCO, INC. ORDERS SHOULD INCLUDE KEPCO PART NUMBER AND DESCRIPTION.

PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS, REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPCO EQUIPMENT OWNERS IN OBTAINING REPLACEMENT PARTS LOCALLY. WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPCO, INC.

PRINTED CIRCUIT BOARD ASSEMBLY (PCB–1), MODEL BKF 15–1.2 (V) Code 3-2570

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (SEE NOTE)	KEPCO PART NO.
R1	1	Resistor,Fixed,Molded 750 ohm, 1 W, 5%	Allen Bradley GB7515	115-2438
R2	1	Resistor,Fixed,Molded 1.5 K ohm, 1 W, 10%	Allen Bradley GB1521	115-0665
R3	1	Resistor,Fixed,Molded 22 K ohm, 1/4 W, 10%	Allen Bradley CB2231	115-2458
R4	1	Resistor,Variable,Cermet 2 K ohm, 3/4 W	Bourns 3009P-1-202	115-2405
R5,6,21,22	4	Resistor,Fixed,Precision,M.F. 2.94 K ohm, 1/4 W, 1%	Dale Type MFF 1/8	115-2457
R7	1	Resistor,Fixed,Molded 1.5 K ohm, 1/2 W, 10%	Allen Bradley EB1521	115-0578
R8,16	2	Resistor,Fixed,Molded 330 ohm, 1/4 W, 10%	IRC GBT-1/4	115-2233
R9	1	Resistor,Variable,Trimpot 500 ohm, 1/8 W	C.T.S. X201	115-1877
R10	1	Resistor,Fixed,Power,Axial 0.4 ohm, 3 W, 3%	Tepro TS-3W	115-2462
R11	1	Resistor,Fixed,Molded 270 ohm, 1 W, 10%	Allen Bradley GB2711	115-0544
R12	1	Resistor,Fixed,Molded 1.2 K ohm, 1/4 W, 10%	IRC GBT-1/4	115-2386
R13,14	2	Resistor,Fixed,Molded 12 K ohm, 1/4 W, 10%	IRC GBT-1/4	115-2276
R15	1	Resistor,Fixed,Molded 100 ohm, 1/4 W, 10%	IRC GBT-1/4	115-2231
R17	1	Resistor,Fixed,Molded 2.2 K ohm, 1/4 W, 10%	IRC GBT-1/4	115-2382
*R18	1	Resistor,Fixed,Precision,M.F. 10 K ohm, 1/4 W, 1%	Dale Type MFF 1/8	115-2174
*R19	1	Resistor,Variable,Cermet 2 K ohm, 3/4 W	Bourns 3009P-1-202	115-2405
*R20	1	Resistor,Fixed,Precision,M.F. 2.74 K ohm, 1/4 W, 1%	Dale Type MFF 1/8	115-2439
R23	1	Resistor,Fixed,Precision,M.F. 15 K ohm, 1/4 W, 1%	Dale Type MFF 1/8	115-2452
**R24	1	Resistor,Fixed,Molded 180 ohm, 1/4 W, 10%	IRC GBT-1/4	115-2385
*R25	1	Resistor,Fixed,Molded 1 K ohm, 1/2 W, 5%	Allen Bradley EB1025	115-0340

*Component used in models with suffix "V" only.
**Component used in models without suffix only.

NOTE:
REPLACEMENT PARTS MAY BE ORDERED FROM KEPCO, INC. ORDERS SHOULD INCLUDE KEPCO PART NUMBER AND DESCRIPTION.

PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS, REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPCO EQUIPMENT OWNERS IN OBTAINING REPLACEMENT PARTS LOCALLY. WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPCO, INC.

MAIN CHASSIS ASSEMBLY, MODEL BKF 15–1.2 (V)

Code 3-2570

SCHEMATIC NO.	QTY.	DESCRIPTION	MFRS. NAME & PART NO. (SEE NOTE)	KEPCO PART NO.
Q201	1	Transistor,NPN	Solitron SES770	119-0082
Q202	1	Transistor,NPN	RCA 40250	119-0068
T201	1	Transformer	Kepco 100-1869	100-1869

NOTE:

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PLEASE NOTE: THE MANUFACTURER'S NAME AND PART NUMBER LISTED FOR EACH ITEM ON REPLACEMENT PARTS LISTS, REPRESENTS AT LEAST ONE SOURCE FOR THAT ITEM AND IS LISTED SOLELY FOR THE CONVENIENCE OF KEPCO EQUIPMENT OWNERS IN OBTAINING REPLACEMENT PARTS LOCALLY. WE RESERVE THE RIGHT TO USE EQUIVALENT ITEMS FROM ALTERNATE SOURCES. KEPCO, INC.

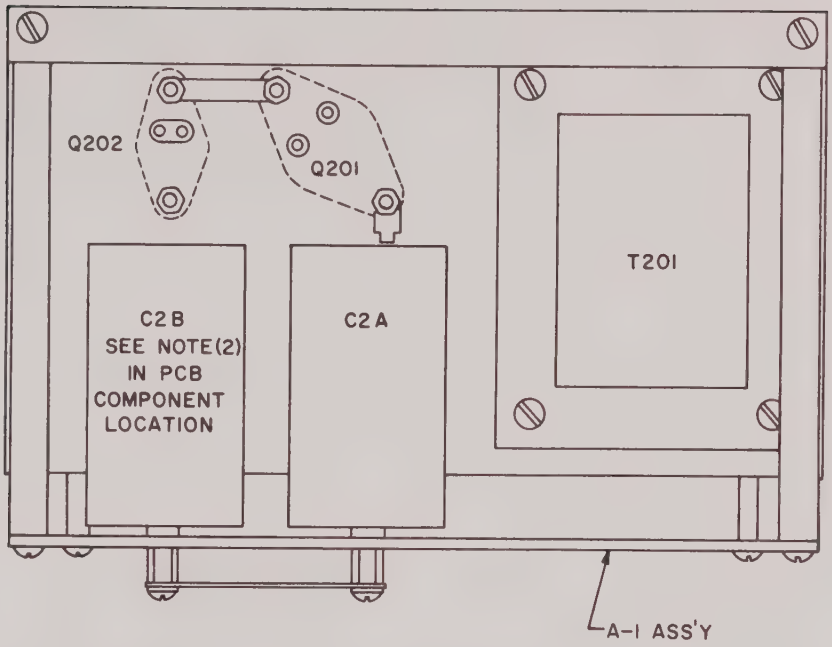
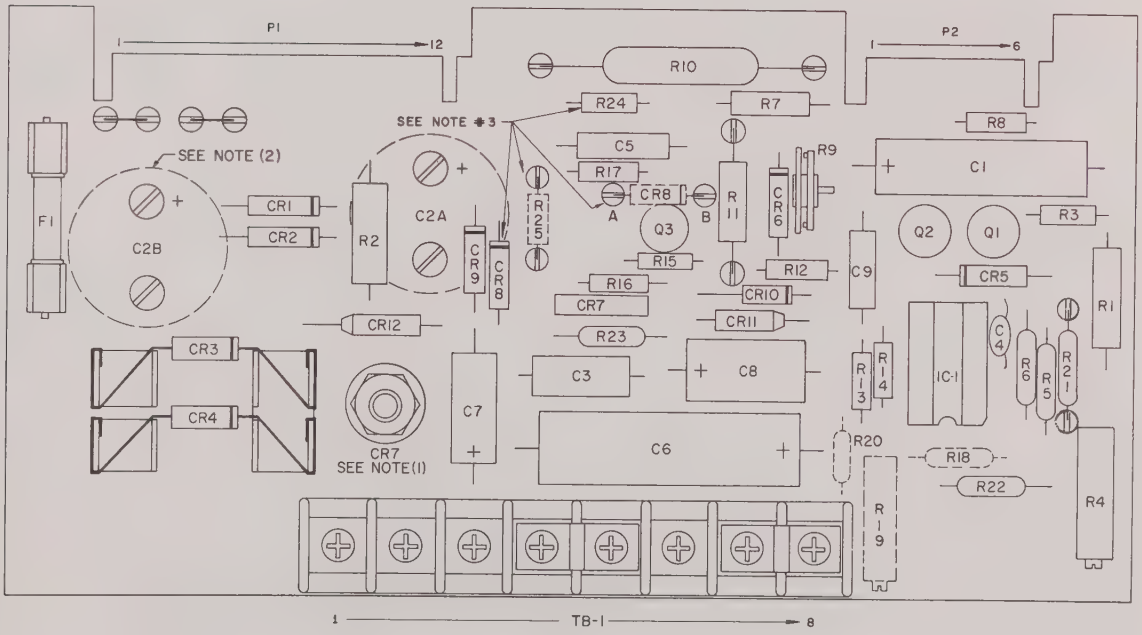


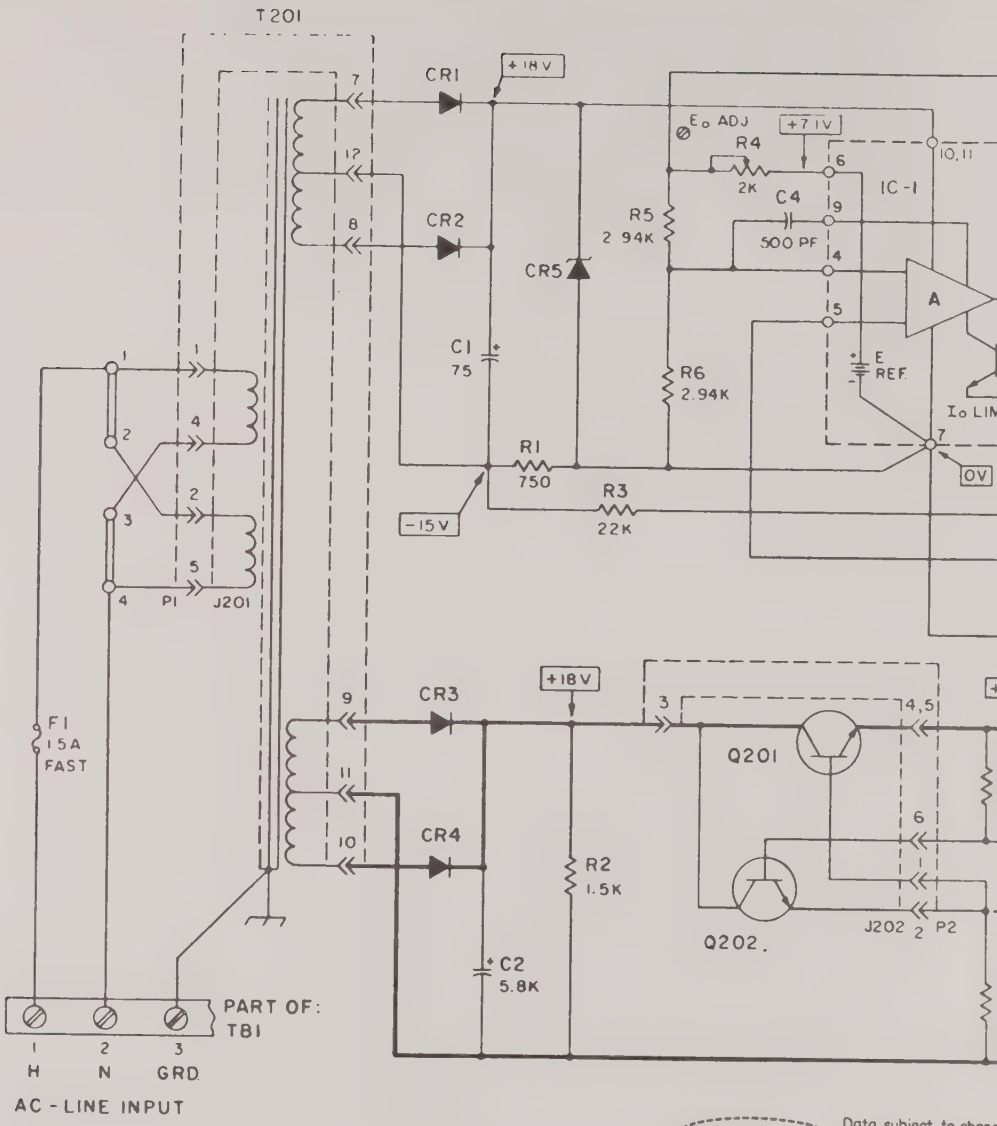
FIG. 6-1 COMPONENT LOCATION, MAIN CHASSIS



NOTES:

1. CR7 (STUD TYPE) NOT USED IN MODELS: BKF 12-1.4, BKF 15-1.2, BKF 24-0.8 AND BKF 28-0.6. SEE CR7 MOUNTED BETWEEN R16 AND R23.
2. C2-B NOT USED IN MODELS: BKF12-1.4, BKF15-1.2, BKF 24-0.8 AND BKF 28-0.6. WHEN C2-B IS NOT USED C2-A BECOMES C2.
3. COMPONENT SHOWN WITH DASHED LINES ARE USED ON MODELS WITH SUFFIX "V" (OPTIONAL ADJUSTABLE OVERVOLTAGE PROTECTOR) ONLY. IN THESE MODELS, THE JUMPER "A" TO "B" IS REMOVED, R24 IS OMITTED AND CR8 IS RELOCATED.

FIG. 6-2 COMPONENT LOCATION, PRINTED CIRCUIT BOARD (A1)



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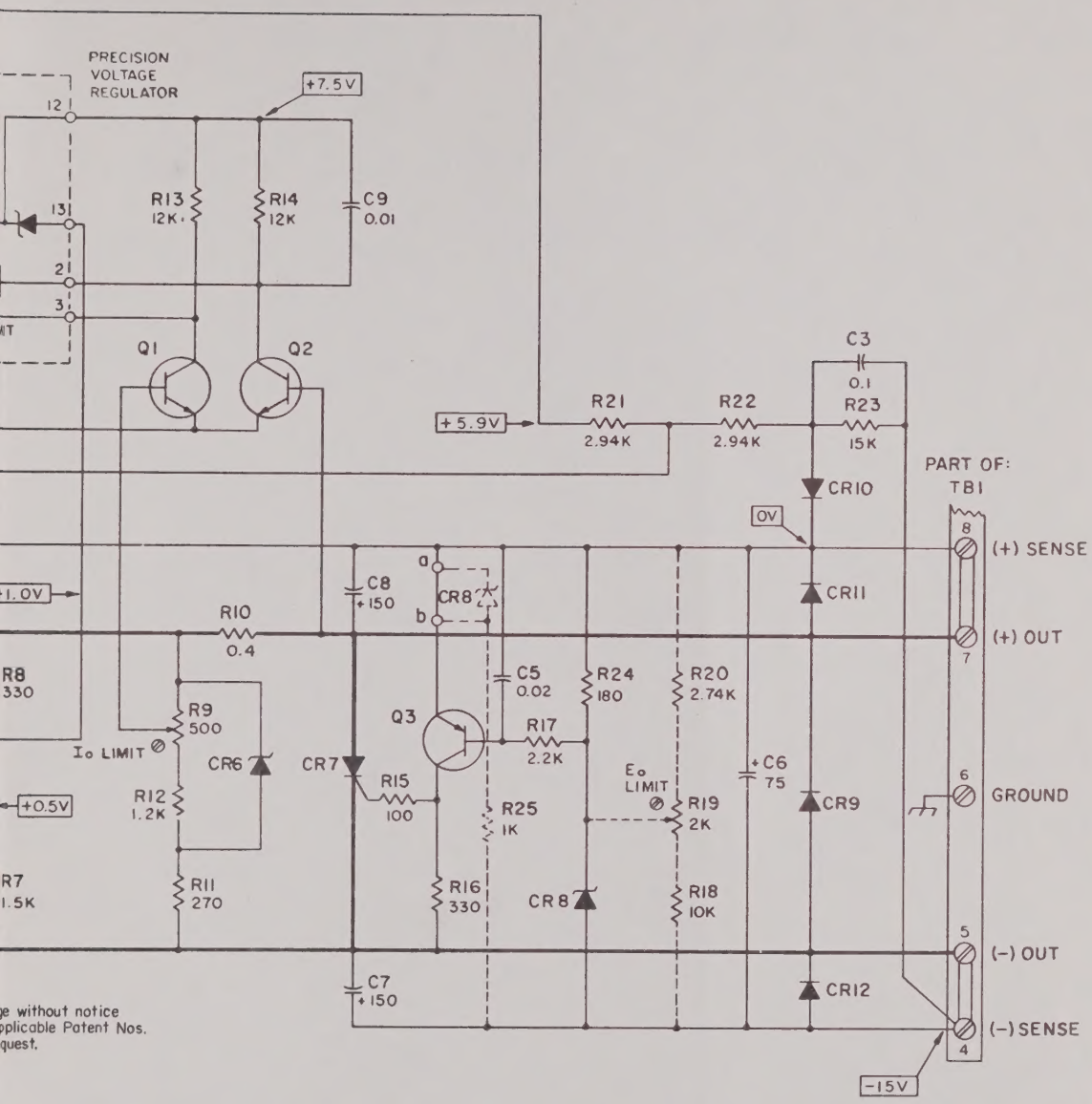
NOTES:

1. RESISTOR VALUES IN OHMS, K=1000
2. CAPACITOR VALUES IN MICROFARADS, K=1000
3. CONDITIONS FOR VOLTAGE MEASUREMENTS:
   A) LINE AT 115V AC, E_o = NOM. RATED, I_o=0
   B) METER, 20K OHMS/VOLT.
   C) READINGS ARE WITH REFERENCE TO THE (+) ERROR SENSING TERMINAL AND SUBJECT TO NORMAL COMPONENT TOLERANCES
4. COMPONENTS AND CONNECTIONS SHOWN WITH DASHED LINES ARE USED ON MODELS WITH SUFFIX "V" (OPTIONAL ADJUSTABLE OVERVOLTAGE PROTECTOR) ONLY. ON THESE MODELS THE JUMPER "a"–"b" IS REMOVED, R24 IS OMITTED, AND CR8 IS RELOCATED AS SHOWN
5. TRANSFORMER CONNECTIONS SHOWN FOR 115V AC
6. ON MODELS WITHOUT SUFFIX (FIXED VOLTAGE PROTECTION) A WIRE JUMPER IS CONNECTED BETWEEN TERMINALS "a" AND "b"
7. UNUSED REFERENCE DESIGNATIONS NONE LAST REFERENCE DESIGNATIONS USED: C9, CR12, F1, Q3, Q202, R25



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IC-1
(TOP VIEW)

N.C.	1	8	N.C.
CURRENT LIMIT	2	9	FREQ. COMP.
CURRENT SENSE	3	10	V(+)
INVERTING INPUT	4	11	Vc
NON-INVERTING INPUT	5	12	V-OUT
V REF.	6	13	Vz
V(-)	7	14	N.C.

FIG. 6-3 MAIN SCHEMATIC, MODEL BKF 15–1.2

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INSTRUCTION MANUAL CORRECTION

ease note the following corrections to the manual material as indicated:

rts List and Schematic Diagram:

CHANGE:	Q202	Transistor		Kepco# 119-0068 to:
	Q202	Transistor		Kepco# 119-0060.
CHANGE:	R13	Resistor, Fixed, Molded	12K ohm, 1/4W, 10%	Kepco# 115-2276 to:
	R13	Resistor, Fixed, Molded	3.3K ohm, 1/4W, 10%	Kepco# 115-2257.
CHANGE:	R14	Resistor, Fixed, Molded	12K ohm, 1/4W, 10%	Kepco# 115-2276 to:
	R14	Resistor, Fixed, Molded	22K ohm, 1/4W, 10%	Kepco# 115-2458.
CHANGE:	R3	Resistor, Fixed, Molded	22K ohm, 1/4W, 10%	Kepco# 115-2458 to:
	R3	Resistor, Fixed, Molded	10K ohm, 1/4W, 10%	Kepco# 115-2211.

F 15-1.2/9-1870/r1 BMC
F 15-1.2/3-2371/r2 C2490

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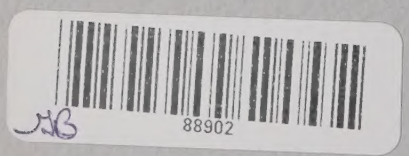

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